HISTORICAL HABITAT

RPA #11 states that Reclamation shall provide an estimate of historical acreage of southwestern willow flycatcher breeding habitat within the Lower Colorado River floodplain from Lake Mead to the Southernly International Boundary. In order to accomplish this task, the Lower Colorado River was divided into five reaches based on historical description (Figure 1):

1) Grand Canyon to Cottonwood Valley

2) Mohave Valley to Mohave Canyon

3) Chemehuevis Valley

4) Great Valley of the Colorado

5) Canebreak Canyon to Mexico

The Colorado River, in its natural state, was a highly dynamic system. Flow rates and duration could change drastically from year to year with little or no correlation between successive years. Flow was seasonal and dependent on snow melt in the Rocky Mountains, mainly. Although flows have been recorded as high as 250,000 cubic feet per second (cfs) at Yuma, years of catastrophic flooding appear to be very rare (USGS, 1973; Stockton, 1975). A catastrophic flood event may be defined as an event which affects all aspects of the floodplain ecosystem for the entire length of the Lower Colorado River. More commonly, flows between 18 cfs and 250,000 cfs occurred (USGS, 1973). These flow regimes could affect a portion of the river but rarely disturbed the entire system. Sediment loading occurred in some areas causing degradation of the river channel, aggradation in other reaches, and the shifting of the river channel itself in still others. Riparian, marsh, and aquatic communities had to be adaptive.

The geomorphology of the river helped dictate where soil deposition, degradation and aggradation occurred. The Lower Colorado River is a series of narrow canyons interspersed with wide valleys. Water and sediment moved rapidly through the narrow canyons in all but the most dry years. These rapid, sediment-filled flows prevented the establishment of most riparian plant communities. Conversely, once the water and sediment were released from a narrow canyon into one of the broad valleys, soil deposition occurred. The rate of aggradation was dependent on flow rate and sediment loading. It was within these large valleys that the native plant communities became established. Sporadic large flows caused the river channel to migrate and created or reconnected oxbows and backwaters.

Table 1. Chronology of the exploration of the Lower Colorado River.

1540	Hernando de Alarcon discovered the Colorado River.
1701-02	Father Eusebio Francisco Kino made two expeditions to the Colorado River.
1744-51	Father Jacobo Sedelmayr traveled through the Colorado River region.
1774	Establishment of a mission at Yuma by Spanish priests.
1774-76	Father Francisco Garces and Captain Juan Bautista de Anza conducted a series of expeditions in the Colorado River region.
1781	Destruction of the mission at Yuma by Yuma Indians.
1826	James Ohio Pattie, an American trapper, explored the Lower Colorado River. Pattie may have been the first US citizen to see the Grand Canyon (Ohmart, 1982).
1846	The Mexican-American War began. The "Army of the West", under General Stephen Watts Kearny, conducted a military reconnaissance of the Southwest, including the Lower Colorado River region.
1846-47	Lieutenant Colonel Philip St. George Cooke led an expedition to follow Kearny's force and open a road to California.
1848	Acquisition of the Lower Colorado River by the United States at the conclusion of the Mexican-American War.
1850	Lieutenant George H. Derby, aboard the schooner "Invincible", explored the Colorado River from the Gulf of California to Camp Independence (Fort Yuma).
1851	Captain Lorenzo Sitgreaves led an expedition down the Bill Williams River to the Colorado.
1852	The first steamboat, the "Uncle Sam", traveled up the Colorado River to resupply Fort Yuma. This marks the beginning of the steamboat trade which would have profound effects on the mature stands of riparian vegetation along the river.
1853	Lieutenant Amiel Weeks Whipple was assigned the task of surveying a new railroad route along the 35th parallel to California.
1854	Gadsden Purchase consummated, extending U.S. territory south of the Gila River to the present international boundary with Mexico. Major William H. Emory was appointed the new Boundary Commissioner and began surveying the newly established boundary between the U.S. and Mexico.
1857	Lieutenant Joseph Christmas Ives, aboard the "Explorer", explored the Colorado River to the head of navigation, Black Canyon.
1860	Dr. J.G. Cooper arrived at Fort Mohave to study wildlife.
1862	Colorado River Gold Rush began after silver was discovered at Eldorado Canyon and gold was discovered at Laguna de la Paz in 1861.
1867	G.W. Gilmore traveled up the Colorado as far as Callville at the head of Black Canyon.
1869	John Wesley Powell explored the Colorado River to the Virgin River confluence.

Table 1. Chronology of the exploration of the Lower Colorado River continued.

1877	Southern Pacific Railroad completed over the Colorado River at Yuma. First diversion of water from the Lower Colorado River by European settlers for irrigation in the Palo Verde Valley near Blythe, California.
1878	Francis Berton, a Swiss prospector, explored the Colorado River.
1883	Atlantic and Pacific railroad completed over the Colorado River at Needles, California. Combined with the Southern Pacific crossing at Yuma and declines in the mining industry, this marks the beginning of the end to the steamboat trade along the Colorado River (Lingenfelter, 1978).
1885	First documented improvements on the Lower Colorado River. Lieutenant S.W. Roessler hired a barge and crew to improve navigation at Six Mile Rapids and Mohave Crossing (Smith, 1972).
1889	Vernon Bailey arrived at Fort Mohave to study wildlife.
1894	Edgar A. Mearns arrived at Yuma to study wildlife.
1895	Construction of Alamo Canal began at Yuma.
1901	Construction of Alamo (Imperial) Canal is completed enabling irrigation of 75,000 acres.
1902	Reclamation Act passed establishing U.S. Reclamation Service. U.S. government began planning large scale irrigations projects (LaRue, 1916).
1905-07	Large flood events break temporary diversion structure at Alamo Canal creating the Salton Sea. 330,000 acres inundated, increasing political pressure to dam the Colorado River.
1909	Laguna Diversion Dam completed.
1910	Dr. Joseph Grinnell explored the Lower Colorado River from Needles to Yuma.
1920	Tamarisk appears along the mainstem of the Colorado River (Ohmart et al., 1988).
1922	Colorado River Compact signed.
1935	Boulder Dam (now Hoover Dam) completed.

Chronology of development along the Lower Colorado River

Native American tribes have called the Lower Colorado River home for centuries. The first European explorers were Spanish priests and military expeditions whose main goals were obtaining gold, silver, and land for Spain (Ohmart, 1982) (Table 1). Journals left by these early Spanish explorers mainly noted the things of concern to the explorers: the native inhabitants and natural resources of immediate use to the Spanish. From the discovery of the Colorado River in 1540 by Hernando de Alarcon until the acquisition of the Lower Colorado River by the United States after the Mexican-American War in 1848, European settlers had little effect on the native habitats found along the Lower Colorado.

Although American fur trappers periodically trapped beaver along the Lower Colorado River and its tributaries in the early 1800's, the first official exploration by the United States didn't occur until war with Mexico was declared in 1846. A military expedition, under the command of General Stephen Watts Kearny, conducted a military reconnaissance from Independence, Missouri to San Diego, including the Lower Colorado River region. Extensive notes on topography, geography, climate, flora, and fauna were taken by William Hemsley Emory, an engineer on the expedition (Emory, 1848). A second expedition, under the command of Lieutenant Colonel Philip St. George Cooke, followed Kearny in 1847 to open a road to California. The notes taken by Cooke detailed a possible railroad route through what is now southern Arizona, prompting Congress to purchase the area south of the Gila River in the Gadsden Purchase of 1854 (Ohmart, 1982).

After the conclusion of the Mexican-American War and the annexation of the Lower Colorado River region by the United States, several military expeditions were undertaken to evaluate the region for mineral wealth, navigable waterways, and overland routes (mainly railroad) to California. Several of these early explorers noted flora and fauna in their journals (United States War Department, 1852; Sitgreaves, 1853; White, 1858; Ives, 1861; Johnson, 1869; Adams, 1871). Many of these early descriptions were made more in passing. Expeditions whose main goal was to study the biotic community of the Lower Colorado River ecosystem were uncommon in the 19th century and early 20th century, with the notable exceptions of Edgar A. Mearns work around Yuma in 1894 (Mearns, 1907) and the Joseph Grinnell-led University of California expedition of 1910 (Grinnell, 1914).

Although several of the early explorers believed that the Colorado River had limited value (Ives, 1861), prospectors began to arrive by the mid-1800's. In 1861, silver was discovered at Eldorado Canyon and gold was found at Laguna de la Paz, creating the Colorado River Gold Rush of 1862 (Lingenfelter, 1978). The Gold Rush fueled the fledgling steamboat trade

along the Colorado River. Initially, downed, dried mesquite, cottonwood, and willow were utilized as fuel by the steamboats (Ives, 1861). However, increased river traffic soon utilized all of the available wood debris so crews began cutting down large quantities of cottonwoods, willows, and mesquites. By 1890, most of the large cottonwood-willow stands and mesquite bosques had been cut over (Ohmart et al., 1988; Grinnell, 1914). Natural flood events still enabled regeneration to occur, however.

Major changes to the Lower Colorado River ecosystem really began with the advent of large-scale agriculture. European settlers first began diverting water from the Colorado River in 1877 to irrigate agricultural lands in the Palo Verde Valley near Blythe, California. In 1885, the first documented instance of alteration of the Lower Colorado River occurred when Lieutenant S.W. Roessler hired a barge and crew to make improvements at Six Mile Rapids and Mohave Crossing for navigational purposes (Smith, 1972). By 1901, water was being diverted for large scale agriculture in the Imperial Valley via the Alamo Canal at Yuma, Arizona (USBR, 1996). In 1902, the United States Congress passed the Reclamation Act which established the U.S. Reclamation Service. The Reclamation Service began to plan large-scale irrigation projects throughout the west, especially along the Lower Colorado River (LaRue, 1916). Additional emphasis was placed on flood control along the Lower Colorado River after the floods of 1905-7, which inundated over 330,000 acres and created the Salton Sea after breaching the diversion structure at the head of the Alamo Canal (Ohmart et al., 1988; USBR, 1996). The solution to the growing needs for water, flood control, and power was to build a series of dams along the Lower Colorado. The Laguna Diversion Dam was the first dam completed on the Colorado River in 1909. Water diverted from Laguna Dam and transported through the Yuma Main Canal irrigated 53,000 acres in the Yuma Valley and 14,700 acres in the Reservation Division in California. An additional 3,500 acres of agricultural land was irrigated from water diverted at Laguna Dam and transported to the Gila Valley via the North Gila Canal (USBR, 1996). The large sediment loads historically found in the Colorado River, estimated to average 160,000,000 tons passing Yuma annually (LaRue, 1916), caused Laguna Dam to silt in almost immediately. From 1913 to 1927, irrigated acreage almost doubled along the Lower Colorado River, going from 53,000 acres to 95,000 acres (Wilber and Ely, 1948).

In 1918, Arthur P. Davis, Reclamation Director and chief engineer, proposed a dam of unprecedented height to be built in Black Canyon, between Nevada and Arizona, to control the Colorado River (USBR, 1985). In 1928, Congress passed the Boulder Canyon Project Act, authorizing the construction of Hoover Dam. Construction began with the diversion of the Colorado River around the damsite through two diversion tunnels on the Arizona side of the river in 1932. Two additional tunnels were constructed on the Nevada side by late 1933. Construction of Hoover Dam was completed on May 29, 1935.

Estimation of historical habitat

The construction of Hoover Dam caused large-scale changes in the Lower Colorado River ecosystem. Natural regeneration of native plant communities became limited with the elimination of annual flood events. Exotic plant species, such as the highly adaptive *Tamarix* sp., have become established and have proliferated with the change in the natural hydrograph. Fire has become a major force in succession of plant communities along the Lower Colorado River. All of these factors have changed the availability and composition of southwestern willow flycatcher breeding habitat.

Table 2. Assumptions used to derive the estimate of historical habitat.

- 1938 aerial photos represent a snapshot of historical habitat that is not an extreme condition
- 1938 aerial photos are inclusive of all riparian habitat between the Grand Canyon and the SIB except::
  - Chemehuevis Valley where habitat estimates were derived from surveyor plats and the 1902 USGS topographic maps.
  - Yuma Valley where much of the historical habitat had been lost after completion of Laguna Dam.
- Habitat delineation from 1938 photos was inclusive rather than exclusive
- The closure of Hoover Dam in 1935 did not greatly influence the riparian habitat by 1938.
- Historical willow flycatcher breeding habitat was comprised of dense willows, often with an overstory of cottonwood.
- Natural stochastic events caused fluctuations in potential willow flycatcher breeding habitat

Estimation of historical southwestern willow flycatcher habitat was based primarily on interpretation of a series of aerial photographs taken by the Bureau of Reclamation in 1938. These photos provided coverage of the floodplain from Hoover Dam to the SIB, with the exception of the Chemehuevis Valley which was about to be inundated by Parker Dam. Old photographs and journals were also used to help define habitat. However, many of these photos and journals were observations made from the river itself and weren't always able to show a complete picture of the entire floodplain. Old surveyor plats were also used to help define habitat within the Chemehuevis Valley.

In order to estimate the amount of southwestern willow flycatcher habitat present prior to 1935, several assumptions were made (Table 2). Until the completion of Hoover Dam, the Colorado River ecosystem had changed very little, with the exception of some development in the Yuma Valley after the completion of Laguna Dam. While Hoover Dam was being constructed from 1932 to 1935, the river was diverted in its entirety through diversion tunnels around the construction site. This diversion had no effect on the river ecosystem outside of Black Canyon.

The Colorado River ecosystem was a highly dynamic system historically (USGS, 1973; Stockton, 1975). For one to assume that the 1938 photos represent a snapshot of historical habitat that is not an extreme in one direction or another, one must look at historical flow data and other influences on the ecosystem in place by 1938. US Geological Survey (USGS) streamflow data and estimated annual water flow from tree ring analysis and other methods

indicate that the water years from 1901 through 1938 were wetter than average but not abnormal (Stockton, 1975; USGS, 1973; Arizona Daily Star, 1998). One can therefore assume that the 1938 photos give a snapshot look at what the river ecosystem was like historically. Any influence Hoover Dam had on the system by 1938 would be limited to small acreages of newly regenerated vegetation within the braided river channel itself that would normally be lost to subsequent floods. Although *Tamarix* began to appear along the Lower Colorado in the 1920's, its abundance was still somewhat limited by 1938 (Ohmart et al., 1988).

The second assumption made when estimating historical acreage related to what constituted willow flycatcher habitat historically. Willow flycatchers nest in dense vegetation from 8 to 25 feet in height. Historically, the nesting strata were primarily comprised of willows, often with an overstory of cottonwoods present. In order to meet the time constraints presented in RPA#11 with the data and equipment available, Reclamation delineated historical acreage from the 1938 photos somewhat liberally. Any stand that was comprised of willows and cottonwoods that were dense enough so that large patches of open ground could not be observed from the photos was delineated. Small open areas, up to 5-10 acres, were not delineated separately from large blocks of nesting habitat. These blocks were then digitized by computer to obtain the estimated number of historical acres. This method may have overestimated the number of historical acres by including open areas within the breeding habitat delineated but it is not unreasonable to assume that these areas had the potential to become nesting habitat at some future time.

Estimation of historical habitat from the Grand Canyon to Cottonwood Valley

Spanish missionaries and explorers first discovered the Grand Canyon and Lake Mead areas in the 1500's (Winship, 1933). These early expeditions, and those in subsequent years conducted by the Spanish, left little or no descriptive information on the native biota of this area. In 1858, the U.S. government sent Lieutenant James C. Ives up the Colorado River from the Gulf of California to ascertain the Colorado River's potential for navigation. Ives' stern wheeler, the "Explorer", ran aground at the south end of Black Canyon. As his crew repaired the damages to the "Explorer", Ives and several others of his party decided to explore Black Canyon by skiff. After several days of struggle against current, Ives concluded that Black Canyon was the limit to practical navigation along the Colorado River. Ives then proceeded overland with several of his party to the Grand Canyon. Ives seemed dutifully unimpressed with the Grand Canyon and the Colorado River stating that "Ours has been the first, and will doubtless be the last, party of whites to visit this profitless locality" (Ives, 1861).

Ives expedition provided the first written comments on the vegetation found within Cottonwood Valley (present day Lake Mohave). He wrote: "The

Cottonwood Valley was found to be only five or six miles in length and completely hemmed in by wild-looking mountains. The belt of bottom land is narrow, and dotted with graceful clusters of stately cottonwood in full and brilliant leaf. The river flows sometimes through green meadows, bordered with purple and gold rushes, and then between high banks, where rich masses of foliage overhang the stream, and afford a cool and inviting shade" (Ives, 1861).

Figure 3. The Colorado River as it emerges from the Grand Canyon, near present-day Pierce Ferry, Arizona (from Freeman, 1923).

During the winter of 1857-58, James L. White ascended the Colorado River aboard the steamship "General Jessup" as far as Cottonwood Valley. He described Cottonwood Valley as being 10 miles long by 3 miles wide with a good growth of cottonwood "probably also contains willow and mesquite" (White, 1858).

In 1867, G.W. Gilmore ascended the Colorado from the Delta to Callville, near present day Callville Bay on Lake Mead, aboard the steamship "Esmeralda". Gilmore described the stretch between Mohave Valley and Cottonwood Valley: "The shores continue of low mesas on each side. There is very little timber to be seen....Cottonwood Island, about 10 miles long by an average of about three miles wide, is a fine, level island, fertile and covered with grass, and having considerable timber". Gilmore further described the river from Cottonwood Island to Callville in the following way: "Leaving Black canon, the country again becomes open, with occasional bottom lands and grass on either side, up to Vegas Wash, six or eight miles distant....There is scarely any timber growing from Black canon to Callville...." (Browne, 1869).

Figure 4. Rioville, Nevada (also known as Bonelli's Landing). It now lies beneath Lake Mead (Books collection, University of Nevada, Las Vegas).

In 1871, Captain Samuel Adams wrote a report to Congress on his explorations of the Colorado River. In this report, Adams states that for 30 miles downstream of Callville all the trees had been cut so that his steamboat was unable to acquire fuel (Adams, 1871).

The Grand Canyon itself was first successfully navigated by John Wesley Powell in 1869. Powell took few notes on the native biota on this trip or on a subsequent trip in 1871. In 1889-90, an expedition led by Robert Brewster Stanton recorded some natural history information and took numerous photographs of the Grand Canyon (Stanton, 1965). Stanton recorded that the

Grand Canyon was basically devoid of vegetation due to the scouring flows it was subjected to each spring.

Julius F. Stone accompanied a party down the Colorado from Green River City, Wyoming to Needles, California, during the fall of 1909. Stone reported that vegetation was very sparse from Lee's Ferry to Black Canyon. Out of approximately 160 photos taken during this portion of the expedition, no photos showed vegetation in a large enough patch to provide willow flycatcher habitat (Stone, 1932).

Figure 5. Cottonwood Valley, circa 1890. This area now lies under Lake Mohave (USGS photo in National Archives, from Ohmart, 1982).

Photographic evidence and journal accounts indicate that willow flycatcher habitat did not exist, or existed in very limited amounts, between Lee's Ferry and Cottonwood Valley (Figures 3 and 4). This is substantiated by the 1938 aerial photos that cover Black Canyon from Hoover Dam to Cottonwood Valley. From all accounts, Cottonwood Valley itself did contain a limited amount of habitat historically (Figure 5). Delineation of the 1938 aerial photos arrived at a figure of 2,146 acres of potential habitat. From Cottonwood Valley south to Mohave Valley, willow flycatcher habitat became scarce once again.

Figure 6. Mohave Valley, 1922, near present-day Bullhead City, Arizona (from Freeman, 1023).

Estimation of historical habitat from Mohave Valley to Mohave Canyon

As with the Cottonwood Valley-Grand Canyon area, the first written descriptions of the Mohave Valley came from U. S. Military expeditions. In 1854, a survey crew, under the command of Lieutenant Amiel Whipple, explored the Colorado in search of a railroad route to California. Whipple passed through the Mohave Valley during the late winter of 1854 and noted that "the soil, for miles from the river, seemed of exceeding fertility" (Whipple, 1856). During the winter of 1858, Lieutenant Joseph Ives entered the Mohave Valley on his expedition to uncover the navigational possibilities of the Colorado River. Ives noted that there was "plenty of timber in the valley" (Ives, 1861). James White, aboard the "General Jessup" in 1857-58, commented that the Mohave Valley was 60 miles long and 10-15 miles wide, with little timber in the lower half but in the upper half, timber was "quite plentiful" (White, 1858).

In late 1860, Dr. J. G. Cooper arrived in the Mohave Valley to study the wildlife found along the Colorado River. Dr. Cooper described the Valley as being about 10 miles wide and consisting mainly of uplands, with a narrow river bottom, not over a mile in width, that "supports a vigorous growth of cottonwoods, willows, and mesquite" (Cooper, 1869).

G. W. Gilmore described the Mohave Valley as "differing little in character until reaching Fort Mohave, about 30 miles above. For this distance the bottom lands prevail, bordered in the distance by the mesa, which occasionally comes up and skirts the river for short distances and then again recedes, leaving long, wide stretches of low lands covered with vegetation, and producing the same timber as that found lower down the river...." (Browne, 1869).

Figure 7. Mohave Canyon, 1910 (Photo by J. Grinnel, from Ohmart, 1982).

In an 1870 report to the U.S. Surgeon General, an assistant surgeon stationed at Fort Mohave described the Mohave Valley: "The plateau extends north and south about 40 miles, with an average width of 10 or 12 miles. There are two reservations, each three miles square. The camp is built on the upper one. The lower reservation is on the low bottom land, about six miles south of the post. Part of it is subject to overflow; the soil is fertile, and is covered with coarse grass, cottonwood, and mesquite trees, with a dense undergrowth of willows and arrow-weed. With this exception the country is a waste" (Stirling, 1870 quoted in Ohmart, 1982).

In the spring of 1889, Vernon Bailey arrived at Fort Mohave to study and collect flora and fauna. He described the Colorado River in the Mohave Valley: "These [river] flats are one to three miles wide and now about 6 feet above water. They are mostly flooded during high water and are traversed by a number of now dry channels, which in places have washed out deeper and contain water....Most of the flats are covered with thick brush and small timber, principally willow, cottonwood and mesquite" (Bailey, 1889 quoted in Ohmart, 1982). Bailey stated, "From Pyramid Canyon, 13 miles north of Ft. Mohave, to Mohave Canyon, 12 miles below Needles, is a broad river valley 42 miles long with brushy and timbered flats near the river and dry, barren mesas' sloping back to low mountains on either side" (Bailey, 1889 quoted in Ohmart, 1982).

Mohave Canyon, the stretch of the river from the Needles extending south to the Chemehuevis Valley, now known as Topock Gorge, appeared to have very little riparian vegetation. Most reports just mention passing through a canyon and entering Mohave Valley (Ives,1861; Browne, 1869). Bailey

noted the lack of vegetation within the canyon (Bailey, 1889 quoted in Ohmart, 1982). Photographic evidence seems to back this hypothesis (Figure 7).

Journals and old photographs indicate that the Mohave Valley contained some willow flycatcher habitat, especially in the northern end of the valley near Fort Mohave (Figure 6). Flycatcher habitat appears to be limited to a narrow belt along the river north of Needles. The 1938 aerial photos show habitat present in noncontiguous patches along the entire valley with the majority of habitat found in the northern half. This would correspond with historical descriptions. The 1938 aerial photos indicate 12,610 acres of potential habitat.

Estimation of historical habitat within the Chemehuevis Valley

The Bill Williams River flows into the Colorado River in the south end of the Chemehuevis Valley. Historically, the Bill Williams was a favorite overland route to the Colorado River. As one of only two major tributaries of the Colorado below Black Canyon, the Bill Williams River and the Chemehuevis Valley were mentioned prominently throughout historical journals as early as the 1700's. Father Jacobo Sedelmayr, a Jesuit missionary, noted in 1744 that the banks of the Colorado near the confluence of the Bill Williams River were "exceedingly high" (Dunne, 1955). In 1775, Father Francisco Garces came upon the Bill Williams-Colorado confluence and reported "I came to a river that I named the Rio de Santa Maria. Its bed is very wide, but at this time [August] it was only half full of water. Along its banks are pasturage and every sort of riverland tree..." (Galvin, 1965).

Figure 8. Chemehuevis Valley, 1910 (from Grinnell, 1914).

In the early 1800's, American fur trappers began to appear in the Southwest. According to Mexican law, it was illegal for foreigners to trap in Mexican territory. However, many trappers circumvented the law by becoming Mexican citizens, being granted special licenses on the condition of training Mexicans to trap, bribery, or evasiveness (Hafen, 1997). Trappers utilized both the Gila and Bill Williams Rivers as travel corridors to the Colorado. Unfortunately, few trappers recorded their discoveries.

In 1851, a United States military expedition, lead by Captain Lorenzo Sitgreaves, followed the Bill Williams River to its confluence with the Colorado. S. W. Woodhouse, a member of the expedition, described the Bill

Williams: “On the banks of this stream are growing willows of several kinds, one of which, affords good fodder for the mules; they oftentimes whilst on this stream had nothing else, and in fact we thought that we were doing well when we found this species of willow; also arrow-wood....and in some places grass.” (Sitgreaves, 1853).

Lieutenant Amiel Whipple’s survey party traveled down the Bill Williams River to the Colorado in 1853 on its way to Los Angeles. In February, 1853, Whipple’s party reached the confluence where Whipple recorded: “The Colorado came from the northwest, meandering a magnificent valley, and having received the waters of the Bill Williams’ fork, entered a chasm among a pile of black mountains below....The Bill Williams’ fork, at the junction, is twenty-five feet wide, and two feet deep....The [Colorado River] is here about two hundred and fifty yards wide, with a current of probably three and a half miles per hour. Above, it appeared wider, deeper, and less rapid. On both banks are strips of bottom lands, from a half mile to a mile wide. The soil is alluvial, and seems to contain less sand and more loam than is found in the valley of the Rio del Notre. But here, as there, are occasionally spots white with efflorescent salts. A coarse grass grows luxuriantly upon the bottoms. Bordering the river are cotton-woods, willows, and mezquites, or tornillas, but more sparsely scattered than in the watered part of the valley of Bill Williams’ fork” (Whipple, 1856).

In 1858, Lieutenant Joseph Ives’ expedition passed the confluence of the Bill Williams and the Colorado on their way to find the head of navigation along the Colorado River. Ives, who had accompanied Whipple during the 1853 expedition, had difficulty finding the mouth of the Bill Williams. Ives wrote in his report to Congress, “I now looked in vain for the creek. The outline of the bank, though low, appeared unbroken, and for a while I was quite confounded. My companions were of the opinion that I made a great topographical blunder, but I asked Captain Robinson to head for the left shore, proposing to camp and make an examination. As we approached the bank I perceived....a small dent, and after landing repaired to the spot, and found a very narrow gully, through which a feeble stream was trickling, and this was all that was left of the Bill William’s Fork. The former mouth is now filled up, and overgrown with tickets of willow” (Ives, 1861).

The next year, James White (1858) passed through the Chemehuevis Valley aboard the steamship “General Jessup”. White noted that the Chemehuevis Valley was a narrow valley with a “considerable portion” of cottonwood, willow, and mesquite extending 12 miles long and 4 to 8 miles in width.

In 1878, Francis Berton, a native of Switzerland who had come to America to prospect for gold, described the Bill Williams-Colorado River confluence in the following way: “Its banks are covered with mesquite trees, willows

and cottonwoods....The Bill Williams' valley is very pleasant; everywhere there are handsome cottonwoods and forests of willows and mesquite" (Berton, 1878; Rudkin, 1953).

In 1889, naturalist Vernon Bailey described the Chemehuevis Valley: "From Mohave Canon the valley widens with brush and cottonwood timber on the flats, until nearing Aubrey - at the mouth of the Bill Williams Fork." (Bailey, 1889 quoted in Ohmart, 1982).

The 1938 aerial photographs of the Lower Colorado River did not include the Chemehuevis Valley. Parker Dam was nearing completion at this time and the Chemehuevis Valley was about to be inundated so, apparently, photos of this area were not deemed necessary. In order to estimate historical willow flycatcher habitat, the original surveyor plats of this area, compiled from 1915-16, were analyzed and overlaid on a series of topographic maps from 1902-03 (USBLM, unpub. data; USGS, 1927). Conclusions drawn from the surveyor notes, topographic maps, historical descriptions, and old photos (Figure 8) show that potential willow flycatcher habitat occurred in the northern portion of Chemehuevis Valley and around the confluence of the Colorado and the Bill Williams Rivers. By overlaying the surveyor notes onto the topographic maps, an estimated 3,500 acres of potential willow flycatcher habitat is believed to exist within the Chemehuevis Valley in the early 1900's.

Estimation of historical habitat within the "Great Valley of the Colorado"

From the confluence of the Bill Williams River, the Colorado River goes south through "a rough canon to pass through between Aubrey and Parker, just before entering the large valley that extends to Canebreak Canon" (Bailey, 1889 quoted in Ohmart, 1982). This is one of the few mentions of what is now known as the Parker Strip in the historical journals. From all indications, this canyon was similar to Black Canyon and Mohave Canyon to the north. The 1938 aerial photos show little, if any, willow flycatcher habitat within this stretch of the Colorado River.

The Great Valley of the Colorado, as named by Grinnell (1914) and undoubtedly countless others before him, extends from present day Parker, Arizona, to the head of Canebrake Canyon, just south of Cibola National Wildlife Refuge. The Great Valley is the most extensive bottom land area along the Lower Colorado River north of Mexico. Early explorers often noted its potential for agriculture (Browne, 1869; Smart, 1870 quoted in Ohmart, 1982; Rudkin, 1953).

Descriptions of the Great Valley varied. Ives (1861) stated in his report to Congress: "The scarcity of vegetation has been alluded to....The mineral wealth of this country somewhat atones for its animal and vegetable poverty,

and in a geological point of view possesses a high degree of interest". Further up the valley, he records, "Since leaving the Chocolate mountains we have traveled sixty five miles....There is a good deal of bottom land, and some of it is fertile; but much of it, as I am informed by Dr. Newberry, is so charged with alkali as to be unproductive....wherever there is bottom land, there is a thick growth of trees near the water, that intercepts the view of the country beyond. Large numbers of these trees are dead and sundried, and furnish excellent fuel". In 1858, James White recorded the Great Valley as being about 145 miles long with cottonwood, willow, and mesquite in "great plenty" back as much as 15 to 20 miles from the river bank (White, 1858).

G.W. Gilmore, traveling aboard the steamship "Esmeralda", observed that "upon new lands formed by the cuttings of the river cottonwood, willow, and mesquite trees will be produced in three years large enough to cut for fuel. Fertile bottom lands extend with little interruption along the banks of the river from Fort Yuma to the Barriers—the first rapids on the river, situated about half-way to La Paz....The bottom lands prevail throughout the distance of 175 miles [Fort Yuma to La Paz], probably covering two-thirds of the way" (Browne, 1869).

Charles Smart, acting assistant surgeon at Camp Colorado (located 40 miles north of La Paz), noted the camp "is placed immediately on the river bank, above overflow, on the low level bottom, which is about 250 yards wide at this point....Some of the fertile bottom lands along the river are cultivated by the Indians. Cottonwood, mesquite, ironwood, willow, and arrow-wood grow along its banks" (Smart, 1870 quoted in Ohmart, 1982).

Berton described his first view of the Great Valley, as he passed Lighthouse Rock, this way: "Nothing ahead of us, to the horizon, but a plain cut by the willow and cottonwood bordered river" (Rudkin, 1953). As Berton proceeded up the Great Valley, he commented on the riparian vegetation he observed: "On the Arizona side we notice some fine cottonwoods behind which a rancho' a farm, called California Camp, 68 miles from Yuma....A fine grove of willows and cottonwoods separates the river from a little ridge, situated a few hundred yards behind it" (Rudkin, 1953). A few miles farther upstream, he notes, "The river is 1,600 or 1,800 feet wide...We pass a fine forest which stretches far into the distance; on the right a sandy plain, subject to flooding; in the distance a line of willows and cottonwoods...There is some fine vegetation on the California side; on the other hand, everything is dry on the Arizona shore" (Rudkin, 1953). Berton continued to observe and comment on the cottonwood and willow growth along the river throughout the Great Valley. After weathering a sand storm and numerous sandbars within the river channel, Berton's party found itself about 100 miles from Yuma on April 13, 1878. Berton commented on seeing on the California side of the river "a dense forest of young trees as far as the eye can reach....This branch of the river and the cliffs, whose bases are bordered by a belt of bushy willows, remind me of the Arve near the forest of La Batie....I

notice the scarcity of birds since our departure from Yuma...We are leaving the cliffs; the river bends to the left in a flat low region. On both sides there are bushes and forests of cottonwoods as far as the eye can reach" (Rudkin, 1953). Berton observed, 25 miles north of Ehrenberg, "an immense prairie covered with coarse swamp-like vegetation [arrowweed]....We see many mesquite trees....they grow more like bushes than trees...The prairie continues; there are fine vegetation and some fine woods...." (Rudkin, 1953).

Bailey described the Great Valley as he traveled south along the Colorado River to Yuma in the following way: "This valley, in which lies the Colorado River Indian Reservation, is about 140 miles long, and I should think in places 15 miles wide. The lowest part is mostly covered with cottonwood and willow timber and brush. The higher ground is open and sandy, with mesquite and creosote brush" (Bailey, 1889 quoted in Ohmart, 1982).

Grinnell (1914) observed the Great Valley and commented on the natural processes the river imposed on the valley and its flora. He noted that the river began to meander soon after exiting the canyon above present day-Parker, with the meanders increasing in extent as the river flowed south through the valley. Grinnell observed the effects of the natural river migration and recorded: "The result [of the river meandering] is that in a short period of years, the major portion of the river's flood-bottom is worked over in the path of this irresistible and continual shifting of the channel. The effect on the flora is obvious. Only in the curves of the valley sheltered by abutting hills are trees given a chance to reach advanced age. The only trees capable of thriving on the unstable portion of the flood-bottom are such as grow rapidly, willows and cottonwoods....The observer, from any appropriate hill-top overlooking the valley, can readily discern the regularly graded heights of tree growth which mark the successive ages of the land on which they grow. The year-old seedlings but a few inches in height form a crescent-shaped belt along the inside of each curve of the river, facing down the valley. Paralleling this and next in position back from the river is dense two-year-old growth, succeeding which is a stand of still older growth. Because of the progressive trend of the process it is as a rule the oldest growth which becomes subject to the razing action of the river...." (Grinnell, 1914).

Grinnell also recorded the periodic occurrence of backwaters and sloughs cut off from the main river channel as the meandering occurred. He noted that these sloughs "are usually short-lived because of the rapid sedimentation at recurring times of general overflow. The bottom land immediately adjacent to the channel, where the latter is fixed for some time, is usually higher than the lateral tracts....At high water these lateral depressions are submerged to a depth of as much as twelve feet, as shown by actual measurement of the upper limit of mud marks on the tree trunks" (Grinnell, 1914). This phenomenon is observable today in places like the Lower Grand Canyon.

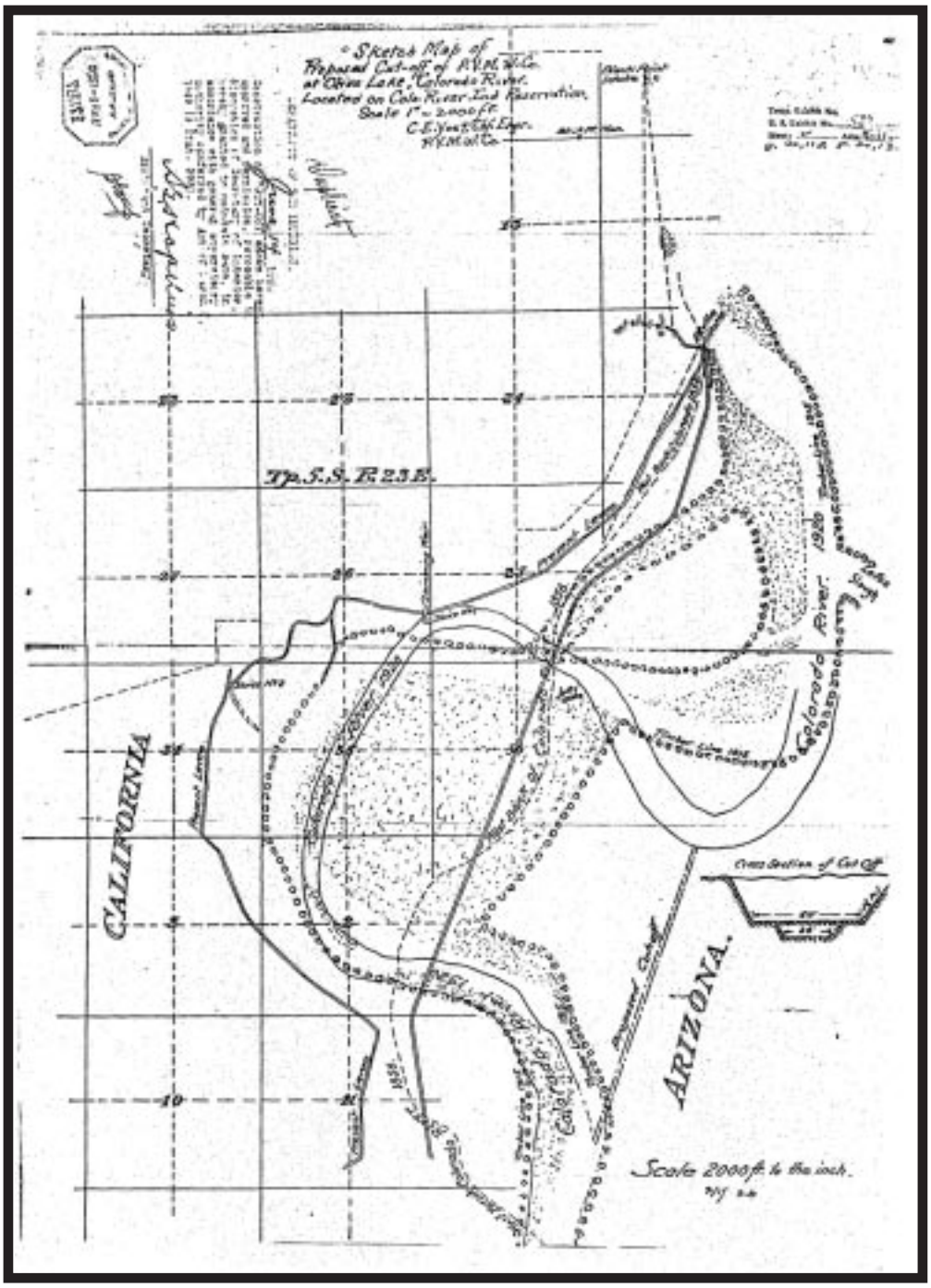

Figure 9. Map of Olive Lake cut-off, near Blythe, California (Yost, 1920. Department of Archives and Manuscripts, Arizona State University).

Detailed maps showing historic vegetation are rare along the Colorado River. In 1920, C.E. Yost, chief engineer for the Palo Verde Metropolitan Water Company (?), sketched a map outlining a proposed cut-off at Olive Lake, near Blythe, California. Yost's map (Figure 9) is interesting as it shows several historic river configurations, including the "Timber Line" as it occurred in 1915. It can be assumed, after reviewing aerial photographs of the area from the 1930's, that Yost's timber line corresponds to the cottonwood-willow community which gives an indication of the how far back from the river's bank line this habitat may have extended in this area in 1915.

In 1938, Reclamation issued a contract for aerial photography of the Lower Colorado River. The 1938 flight acquired complete photo coverage of the Great Valley floodplain from Parker to Canebrake Canyon. Analysis of these photos showed 43,984 acres of potential willow flycatcher habitat within the Great Valley in 1938. Historical journals, maps, and photographs collaborate this estimate (Figure 10). Although agriculture had already become established within the valley by 1938, these areas were above the cottonwood-willow bottom lands due to the instability of the river at this time.

Estimation of historical habitat from Canebrake Canyon to Mexico

As the Colorado River exits the Great Valley, it flows through a canyon known historically as Canebrake or Canebreak Canyon (Figure 11). The

stretch of the river from Canebrake Canyon to Explorers Pass, at the head of Yuma Valley, differed geomorphologically from the canyons upstream of the Great Valley. While many stretches of Canebrake Canyon area were narrow, with limited vegetation as was the Grand Canyon, Black Canyon, Mohave Canyon, and the Parker Strip, there were several small valleys within this stretch that allowed for vegetation to become established, if only for short periods of time.

Figure 10. Ehrenberg, Arizona (Arizona Historical Society).

In 1858, Lieutenant Joseph Ives and his party traveled through Canebrake Canyon on their expedition to find the head of navigation on the Colorado River. Ives recorded, "The country through which we have passed is quite destitute of vegetation. Closer to the river is an occasional growth of mezquite, cottonwood, or willow, which furnishes abundant materials for fuel; but the hills are bare, and gravelly beds of the valleys sustain only desert shrubs" (Ives, 1861). Ives also noted that the banks of the river were lined with a thick growth of reeds that overhung the water.

Figure 11. Canebrake Canyon (from Dellenbaugh, 1902).

Berton, in 1878, traveled through the Canebrake Canyon area and left the following descriptions: "At dawn we go on again up the river [from the Yuma Valley], which is narrowing perceptibly....The California shore is covered with mesquite and reeds called arrow-points', but the mountain behind is completely bare of vegetation....The river widens out again, and we are crossing a small plain....The plain is disappearing and we are entering a canon (gorge), where the river narrows and becomes more rapid. On each side there is a screen of bushes and reeds....We reach Castle Dome landing, 35 miles from Yuma....On the California side one sees only white sand, without any vegetation....there are tufts of bushes and some cacti on the Arizona side, which is higher. Farther on the river divides into two branches which enclose a little island covered with shrubbery and fine cottonwoods....We are coming to "Chimney Pick Canon", 45 miles from Yuma....I see only cactus and reeds....We are 50 miles from Yuma....The place is rather pretty; there are many willows and some cottonwoods...." (Rudkin, 1953).

Bailey passed through Canebrake Canon, in 1889, on his way to Yuma. He observed that "Canebreak canyon is about 50 miles above Yuma where the river cuts through the last range of mountains before reaching the Gulf. The mountains are low, rough, perfectly bare rock. The river through the canon is rather straight, with low rocky banks and fringed most of the way with a dense hedge of reed - Phragmites communis, I suppose - which occupy all the soil at the water's edge and hang over the tops of the lower ones in the water" (Bailey, 1889 quoted in Ohmart, 1982).

Once the Colorado River exits the last of the canyons at Explorers Pass, it enters another large alluvial floodplain named the Yuma Valley. The Gila River, the Colorado's second major tributary below Black Canyon, enters the Colorado within the Yuma Valley. This major landmark is mentioned repeatedly in historical journals since the Spanish explorations. In 1774, Spanish missionaries established a mission at the confluence of the Colorado and Gila Rivers, at present day Yuma, Arizona. An uprising by the Yuma Indians in 1781 led to the destruction of the mission (Ohmart et al., 1988). In 1850, after war with Mexico, the United States established a military post at the confluence named Camp Independence, which was later renamed Fort Yuma.

Early Spanish explorers noted the Yuma Valley, especially the Gila-Colorado confluence, in their journals. Father Jacobo Sedelmayr passed through the Yuma Valley in 1744 and described the confluence area as having a "rich growth of trees, with an expanse of pasture land in the depression of the river, and with the variety of trees which clustered along the water's edge" (Dunne, 1955). From 1774 through 1776, Captain Juan Bautista de Anza conducted several expeditions along the Colorado River in conjunction with several Franciscan missionaries. In December, 1775, during his second expedition, Anza described the area just south of Pilot Knob as "impenetrable tickets of various kinds of trees and brush" (Bolton, 1930). The following May, Anza recorded that the Colorado River at the confluence with the Gila was impossible to ford "because of the great marshes encountered before reaching it and after entering it, to which are added very dense thickets" (Bolton, 1930). Father Pedro Font accompanied Captain Anza on his second expedition and described the difficulty in traveling the area around Pilot Knob: "The road, although nearly all level, was very difficult, because it was so thick with brush that in many places not more than a little trail was to be seen, the rest being densely grown with mesquite, tornilla [screwbean mesquite], and thickets of a shrub which they call cachanilla [arrowweed]" (Bolton, 1930).

In the early part of the 19th Century, the Gila River became a major travel corridor for American fur trappers to reach the Colorado River. In 1826, James Pattie, possibly the first US citizen to see the Grand Canyon (Ohmart, 1982), described the Colorado River near its confluence with the Gila as "between two and three hundred yards wide, a deep, bold stream, and the water at this point entirely clear. The bottoms are a mile in general width,

with exceedingly high, barren cliffs. The timber of the bottoms is very heavy, and the grass rank and high. Near the river are many small lakes, which abound in beavers" (Thwaites, 1905). Later that year, Pattie described the Colorado below its confluence with the Gila as "2 to 300 yards wide, with high banks that have dilapidated by falling in. Its course is west, and its timber chiefly cotton-wood, which in the bottoms is lofty and thick set. The bottoms are six to ten miles wide" (Thwaites, 1905).

In 1846, the United States sent a military expedition under General Stephen Kearny to explore the Colorado River region. William Hemsley Emory, an engineer with Kearny's force, described the Colorado River in the vicinity of the Gila-Colorado junction as being "perfectly straight, and about 600 feet wide" (Emory, 1848). He stated: "We traveled over a sandy plain a few miles, and descended into the wide bed of the Colorado, overgrown thickly with mezquite, willow, and cotton-wood; after making about ten miles, we encamped abreast of the ford on a plateau covered with young willows...." (Emory, 1848). Emory describes the ford as "narrow and circuitous, and a few feet to the right of left sets a horse afloat.....The growth on the river bottom is cotton-wood, willow of different kinds, Equisetum hymale (scouring rush), and a nutritious grass in small quantities" (Emory, 1848). Captain A.R. Johnson, another member of Kearny's party, described the same march: "...marched about ten miles to the river, and encamped on the sand bar, the willows being about 10 feet high and thick, with a good deal of grass mixed in their roots; the river is perhaps one third of a mile wide....the bottom, on the river here is about ten miles wide,and much of the land could bear cultivation; it is all now overgrown with almost impenetrable thickets of willows, mesquite, and Fremontia [cottonwood]...." (Emory, 1848).

In 1850, John R. Bartlett was appointed Boundary Commissioner and tasked to survey the newly established boundary between the United States and Mexico. Bartlett described the Colorado River as it wound through the Yuma Valley: "The Colorado flows through a bottom or valley from two to four miles in width, thickly covered with cotton-wood and mezquit; beyond which is the desert....I should think that the bottom-land of the Gila was from three to four miles wide near the junction. The portion towards the river is thickly covered with cotton-wood, and with willows on the margin, while further back has nothing but mezquit" (Bartlett, 1854).

Several other travelers published reports which contained references to the Yuma Valley. A. B. Clark recorded that one and a half miles below the confluence the Colorado was "a thick growth of willows and cottonwoods, filled up with canes, vines, and weeds along the bank, through which it is difficult to penetrate. Farther back are clusters of mesquite..." (Clarke, 1852). In 1853, William P. Blake noted, "Our course, at first, lay over the bottom-lands of the Colorado, among cottonwoods, willows, and clumps of mezquite trees" from Fort Yuma to the mountains north of Pilot Knob (Blake, 1857). In 1875, J.V. Lauderdale and G. S. Rose, assistant surgeons, described the

area around Fort Yuma: “The bottom land surrounding the fort and forming the right bank of the river, is covered with a heavy growth of arrow-weed, mesquite, and willow, and is intersected by a number of sloughs and lagoons, former beds of the river” (Lauderdale and Rose, 1875 quoted by Ohmart, 1982). In 1878, Berton described Fort Yuma: “It overlooks the desert and the banks of the Colorado, which are covered with vegetation. The lowlands are full of cottonwood and mesquite....” (Rudkin, 1953). As he traveled up the Colorado through the Yuma Valley, Berton noted, “The river banks are covered with cottonwoods and mesquite, the country is flat; the desert begins a half-mile from the river on both sides” (Rudkin, 1953). Vernon Bailey described the Yuma Valley in 1889: “From the town southward the valley, or river flats, widens out and seems to stretch away to the Gulf in a broad level tract of country but 10 to 15 feet higher than the river. A belt of cottonwood and willow timber extends at least 10 miles below on the west side of the river. The flats on the east side and farther back on the west are mostly covered with small saline shrubs, creosote bush, and mesquite trees....” (Bailey, 1889 quoted in Ohmart, 1982).

Figure 12. The confluence of the Colorado and Gila Rivers (from Dellenbaugh, 1902).

Figure 13. Yuma, 1916 (from the Forbes Collection, Arizona Historical Society, Tucson, Arizona).

In 1894, Edgar A. Mearns traveled to the Yuma area to study mammals. He describes the general vegetation pattern of the Lower Colorado River: “The river channel is marked by a line of unusually tall cottonwoods and a lesser fringe of willows (*Salix fluviatilis*). The adjacent bottom lands are covered more or less with mesquite and tornillo....The common shrubbery is a dense and monotonous growth of arrowwood (*Pluchea sericea*) and, in places, of *Baccharis*” (Mearns, 1907). Mearns described Yuma similarly: This station is on the left (east) bank of the Colorado River, at the mouth of the Gila. “The channels of the Gila and Colorado rivers are marked by lines of tall cottonwood and a lesser fringe of willows. The adjacent bottom lands, which are broad and subject to annual overflow from the river, are more or less covered with mistle-toe matted mesquites and screwbeans....the commonest shrubs of the low ground are the arrowwood and *Baccharis*. As a result of an investigation along the Colorado River, made in January, 1902, by the hydrographic branch of the U.S. Geological Survey, the extent of the alluvial bottom land between Camp Mohave and Yuma was found to be from 400,000 to 500,000 acres” (Mearns, 1907).

Figure 14. Laguna Dam site, 1908 (from the Forbes Collection, Arizona Historical Society, Tucson, Arizona).

Grinnell (1914) noted that Laguna Dam, which was built at the head of the Yuma Valley in 1909, had a “pronounced modifying influence on the flora and fauna of the vicinity”. Grinnell observed that the existing riparian

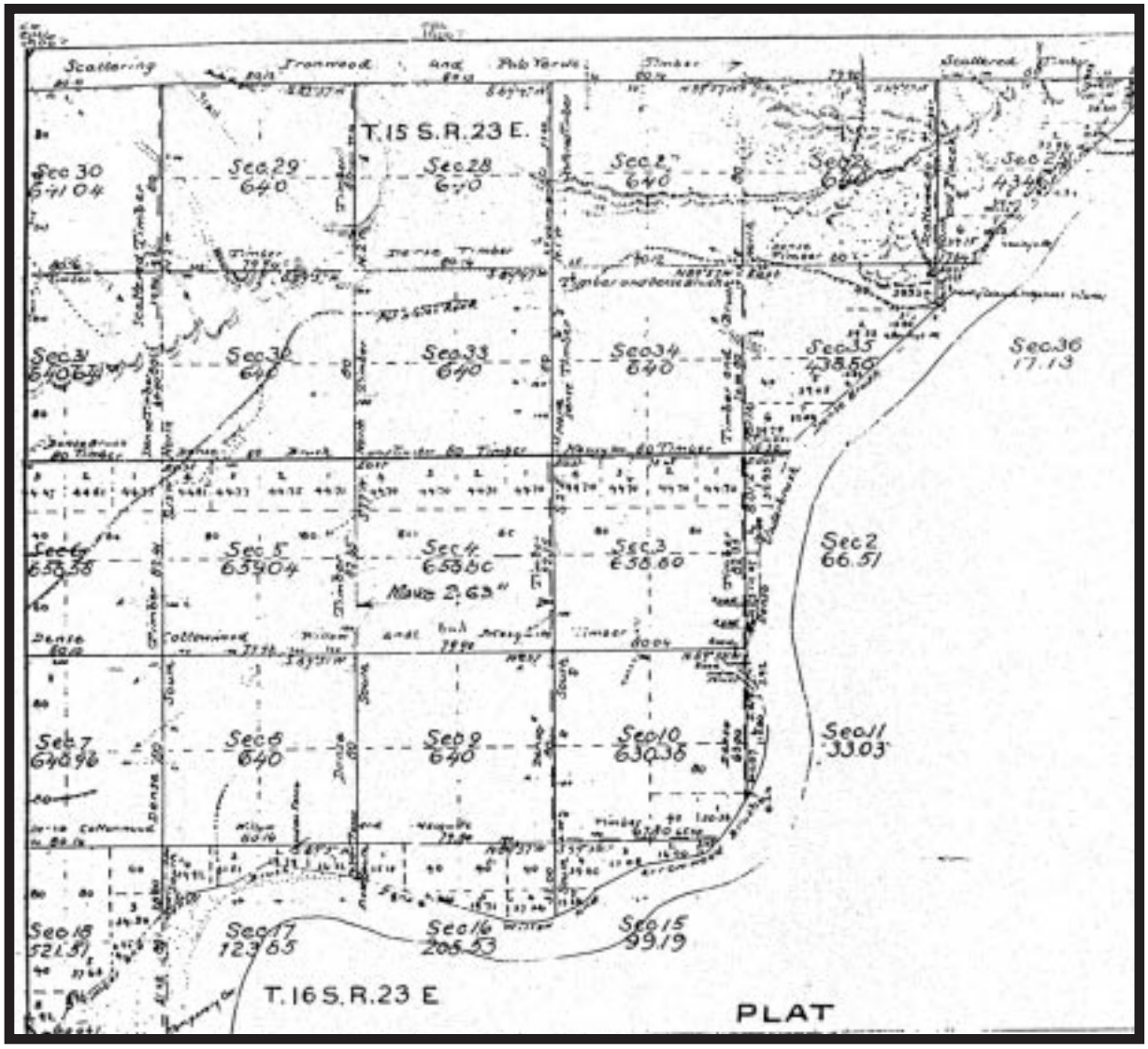

Figure 15. Map of Bard, California, area, circa 1900 (USGS, 1900. Department of Archives and Manuscripts, Arizona State University).

vegetation above the dam had been lost to inundation and that arrowweed had colonized the mudflats created by the heavy silt deposition above the dam. Grinnell also noted the changes to the ecosystem below the dam. He observed an increase in scouring below Laguna Dam that helped create a seven foot drop in the river channel which affected riparian vegetation. Grinnell states: "Thus the former flood-bottom was, in 1910, far above flood level, and in a way to become good second bottom, with appropriate metamorphosis in vegetation and fauna. Although these changes were local, and due to man's interference, similar ones, due to natural causes, have doubtless occurred from time to time in various parts of its course in the river's history, thus repeatedly shifting the riparian strips both in position and total width...." (Grinnell, 1914).

The completion of Laguna Dam enabled large-scale agriculture to become established in the Yuma Valley. By 1938, when the aerial photos were taken, portions of the valley that may have contained willow flycatcher habitat historically, were being farmed. Analysis of the 1938 photos indicated

approximately 11,136 acres of potential willow flycatcher habitat from Canebrake Canyon to Yuma. Analysis of historical journals, photographs, and old maps indicate that an additional 9,000 acres of potential habitat may have been present prior to Laguna Dam (Figures 12, 13, and 14). General descriptions of vegetation composition were used in conjunction with the 1902-03 topographic maps of the river and a turn-of-the-century USGS map of Bard to help in this estimation (Figure 15).

The 1938 aerial photos also showed an additional 3,827 acres south of Yuma, along both sides of the river, to the Southerly International Boundary. This area, known now as the Limitrophe, was also under the plow by 1938. After reviewing the historical descriptions and old photographs, an additional 3,000 acres were added to the total digitized from the 1938 aerial photos. This figure represents an estimate of the amount of cottonwood-willow habitat lost adjacent to the mainstem of the Colorado River and surrounding backwater areas present on the aerial photos to agricultural encroachment by 1938.

Summary of estimation of historical habitat

Since the Colorado River was such a dynamic system historically, the amount of southwestern willow flycatcher breeding habitat varied through time in correlation with historical flow. Journal excerpts often describe varying conditions along the Lower Colorado River. In order to fully define historical habitat, one must describe the potential range in historical acreage.

Table 3. Estimate of historical habitat, by river reach, as delineated from the 1938 aerial photography (with appropriate adjustments)

River Reach	1938 Digitized Acres	Adjustments	Totals
Cottonwood Valley	2,146		2,146
Mohave Valley	12,610		12,610
Chemehuevis Valley		3,500	3,500
Great Valley	43,984		43,984
Yuma Valley*	11,136	9,000	20,136
Limitrophe**	3,827	3,000	6,827
Totals	73,703	15,500	89,203

*Yuma Valley includes Canebrake Canyon
**Limitrophe Digitized acres include both the U.S. and Mexico sides of the river

Analysis of the 1938 aerial photos, including the adjustments for agriculture present by that time and the lack of coverage within the Chemehuevis Valley, show an aggregate total of approximately 89,200 acres of potential willow flycatcher breeding habitat from the southern end of the Grand Canyon to the Southerly International Boundary (Table 3). This number is likely on the high end of the historical scale for the following reasons:

1) Descriptions of the Lower Colorado River generally agree with Grinnell's explanation of the processes involved within the Great Valley (Figure 16)

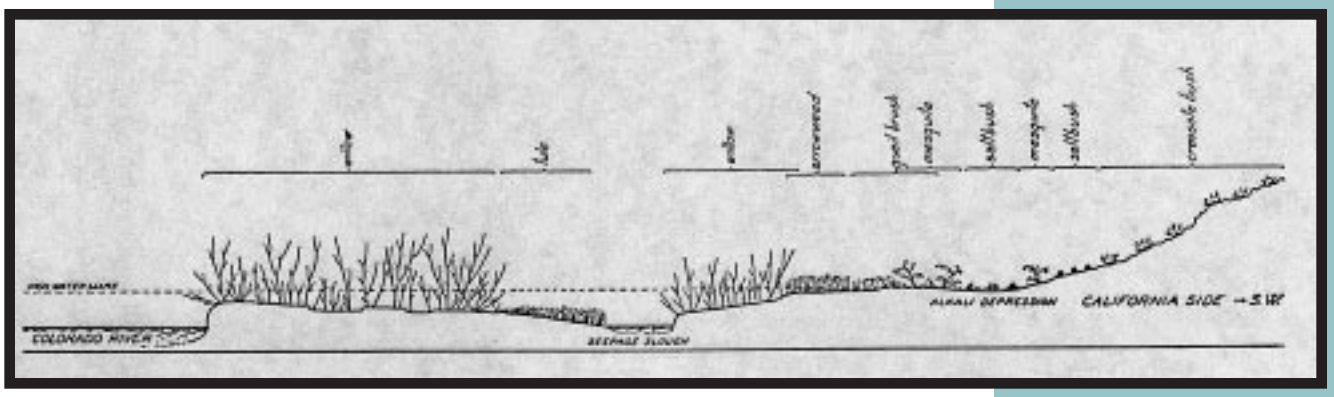

Figure 16. Profile of a section of the Lower Colorado River (from Grinnell, 1914).

(Grinnell, 1914). However, many of the early descriptions failed to differentiate between cottonwood, willow, and mesquite habitats. At first glance, one might assume that the early explorers didn't feel the need to differentiate between the "trees" but after reviewing surveyor plats (Figure 17), it becomes obvious that these species often grew in mixed stands or in clumps within other vegetation types (USBR, 1996; Ohmart et al., 1977). Analysis of the 1938 aerial photographs reveal the same tendency. In the analysis of the 1938 aerial photos, many clumps of non-flycatcher habitat (mesquite, arrowweed, areas of scattered density, etc.) were included within the general boundaries delineated simply because they were too small to delineate separately or because the quality of the 1938 photos made typing small clumps extremely difficult.

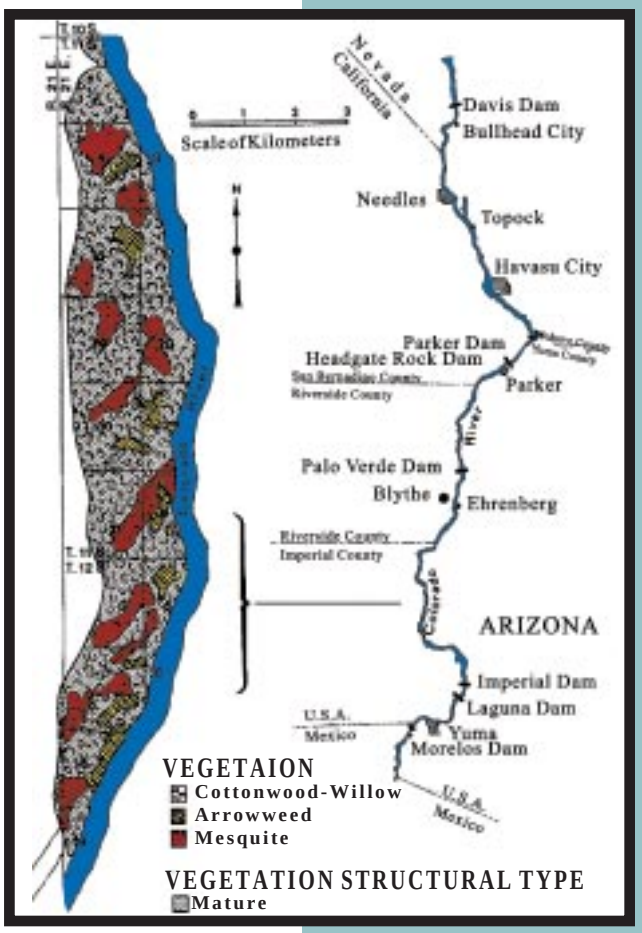

Figure 17. Vegetation communities, derived from surveyor plats, along a section of the Colorado River near Blythe, California, 1879 (from Ohmart et al., 1977).

2) Analysis of data derived from tree rings and clam shells by the University of Arizona has given an estimate of water flow on the Colorado River over the last 450 years (Stockton, 1975; Arizona Daily Star, 1998). USGS flow data indicate that the years from 1900 to the completion of Hoover Dam in 1935 were generally wetter than average (USGS, 1973). Disturbance caused by the higher flows created conditions more suitable for southwestern willow flycatcher by providing areas of moist, bare mineral soil needed for willow germination. Historically, southwestern willow flycatchers utilized early successional stands of willow for breeding habitat.

3) By 1938, man had disturbed the natural ecosystem for almost 100 years. The demand for fuel by the steamboat trade had eliminated most of the mature cottonwood-willow gallery forests south of the Grand Canyon (Grinnell, 1914; Ohmart et al., 1988; Lingenfelter, 1978). These stands were often still cottonwood and willow but at an earlier successional stage that was even more attractive to the willow flycatcher. The construction of Laguna Dam had enabled large-scale agriculture to develop within portions